IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application No.: 10/821,371	§	Examiner: Patel, K. M.
Filed: April 9, 2004	§	Group/Art Unit: 2188
Inventor(s):	§	Atty. Dkt. No: 5181-25901
Landin et al.	§	Confirm No. 1212
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Title: MULTI-NODE SYSTEM WITH GLOBAL ACCESS STATES	§	
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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir/Madam:

Further to the Notice of Appeal of April 7, 2008, Appellants present this Appeal Brief. Appellants respectfully request that this appeal be considered by the Board of Patent Appeals and Interferences.

I. REAL PARTY IN INTEREST

The subject application is owned by Sun Microsystems Inc. An assignment of the present application to the owner is recorded at Reel 015207, Frame 0621.

II. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to Appellant.

III. STATUS OF CLAIMS

Claims 7-29 are pending. Claims 1-6, and 30 are cancelled. Claims 7-29 are rejected under 35 U.S.C. § 103(a). It is these rejections that are being appealed. A copy of claims 7-29 is included in the Claims Appendix attached hereto.

IV. STATUS OF AMENDMEMNTS

No unentered amendment to the claims has been filed after final rejection. The Appendix hereto reflects the current state of the rejected claims.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

A multi-node computer system includes a plurality of nodes that are interconnected. The nodes implement a coherency protocol such that if an active device in one of the nodes has an ownership responsibility for a coherency unit, no active device in any of the other nodes has a valid access right to the coherency unit. For example, if a node receives a coherency message requesting read access to a coherency unit from another node, the node may respond by conveying a proxy address packet on the node's address network to an active device. Receipt of the proxy address packet may remove the active device's ownership responsibility for the coherency unit. In contrast, an active device within the node may request read access to a coherency unit by sending an address packet on the address network. Receipt of the address packet by an active device having an ownership responsibility for the coherency unit may not remove that device's ownership responsibility.

Independent claim 1 is directed to a multi-node computer system (*See* e.g., FIG. 20, #100) includes a node (*See* e.g., FIG. 20, #140A). The node may include a plurality of active devices (*See* e.g., FIG. 20, #142AA, #142BA, #146A) and an interface (*See* e.g., FIG. 20, #148A) coupled by an address network (*See* e.g., FIG. 20, #150A) configured to convey address packets between the interface and the plurality of active devices, and a data network (*See* e.g., FIG. 20, #152A) configured to convey data packets between the interface and the plurality of active devices. The address network and the data network are separate networks (*See* e.g., specification page 11, lines 18-20). The node also includes an inter-node network (*See* e.g., FIG. 20, #154) configured to convey coherency messages between the interface in the node and an additional interface in an additional node (*See* e.g., specification page 63, lines 7-15). The additional interface is configured to send a coherency message requesting a read access right to a coherency unit on the inter-node network, a given active device of the plurality of active devices has an ownership responsibility for the coherency unit. The interface is configured to respond to the coherency message by sending a proxy address packet on the address network (*See* e.g., specification page 90, line 28 through page 91, line 4). A different active device of

the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network (*See* e.g., specification page 36, lines 27-30). The given active device of the plurality of active devices has an ownership responsibility for the another coherency unit. The given active device is configured to not transition the ownership responsibility for the another coherency unit in response to the address packet (*See* e.g., specification page 37, lines 1-6) and to transition the ownership responsibility for the coherency unit in response to the proxy address packet (*See* e.g., specification page 91, lines 7-10).

Independent claim 18 is directed to a node (*See* e.g., FIG. 20, #140A) for use in a multi-node system (*See* e.g., FIG. 20, #100). The node includes an address network (*See* e.g., FIG. 20, #150A) configured to convey address packets and a separate data network (*See* e.g., FIG. 20, #152A) configured to convey data packets. The node also includes a plurality of active devices coupled to send and receive address packets on the address network and data packets on the data network (*See* e.g., specification page 11, lines 18-20), wherein a given active device of the plurality of active devices has an ownership responsibility for a coherency unit. An interface (*See* e.g., FIG. 20, #148A) coupled to additional nodes (*See* e.g., FIG. 20, #140B, #140C) in the multi-node system via an inter-node network (*See* e.g., FIG. 20, #154). The interface is configured to send and receive address packets on the address network and data packets on the data network. The interface is configured to receive a coherency message from a given additional node via the inter-node network (*See* e.g., specification page 63, lines 7-10). The coherency message requests a read access right to the coherency unit. The interface is configured to respond to the coherency message by sending a proxy address packet on the address network (*See* e.g., specification page 90, line 28 through page 91, line 4). A different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network (*See* e.g., specification page 36, lines 27-30). The given active device of the plurality of active devices has an ownership responsibility for the another coherency unit. The given active device is configured to not transition the ownership responsibility for the another

coherency unit in response to the address packet (*See* e.g., specification page 37, lines 1-6) and to transition the ownership responsibility for the coherency unit in response to the proxy address packet (*See* e.g., specification page 91, lines 7-10).

Independent claim 22 is directed to a method for use in a multi-node system (*See* e.g., FIG. 20, #100) comprising a node (*See* e.g., FIG. 20, #140A) and an additional node (*See* e.g., FIG. 20, #140B) coupled by an inter-node network (*See* e.g., FIG. 20, #154). The method includes the additional node sending a coherency message requesting a read access right to a coherency unit on the inter-node network (*See* e.g., specification page 63, lines 7-15), and in response to receiving the coherency message, an interface (*See* e.g., FIG. 20, #148A) included in the node sending a proxy address packet on an address network included in the node (*See* e.g., specification page 90, line 28 through page 91, line 4). An active device included in the node losing an ownership responsibility for the coherency unit in response to receiving the proxy address packet (*See* e.g., specification page 91, lines 7-10), and a different active device included in the node requesting a read access right to another coherency unit by sending an address packet on the address network (*See* e.g., specification page 36, lines 27-30). The active device maintaining an ownership responsibility for the another coherency unit in response to the address packet (*See* e.g., specification page 37, lines 1-6).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Claims 7-15, and 18-29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rowlands et al. (U.S. Patent No. 6,948,035) (hereinafter "Rowlands1") in view of Rowlands et al. (U.S. Patent Publication No. 2004/0034747) (hereinafter "Rowlands2"), and Chen et al. (U.S. Patent No. 6,931,496).

2. Claims 16-17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rowlands et al. (U.S. Patent No. 6,948,035) (hereinafter "Rowlands1") in view of Rowlands et al. (U.S. Patent Publication No. 2004/0034747) (hereinafter "Rowlands2"), Chen et al. (U.S. Patent No. 6,931,496), and Hagersten et al. (U.S. Patent No 5,940,860).

VII. ARGUMENT

First Ground of Rejection:

Claims 7-15, and 18-29 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rowlands1 in view of Rowlands2, and Chen. Appellant traverses this rejection for at least the following reasons.

Claims 7, 18, and 22

Appellant respectfully submits that each of claims 7, 18, and 22 recites a combination of features not taught or suggested in Rowlands1, Rowlands2, Chen.

For Example, Appellant's claim 7 recites a multi-node system comprising

> a node including a plurality of active devices and an interface coupled by an address network configured to convey address packets between the interface and the plurality of active devices, and a data network configured to convey data packets between the interface and the plurality of active devices, wherein the address network and the data network are separate networks;
>
> an inter-node network configured to convey coherency messages between the interface in the node and an additional interface in an additional node, wherein the additional interface is configured to send a coherency message requesting a read access right to a coherency unit on the inter-node network, wherein a given active device of the plurality of active devices has an ownership responsibility for the coherency unit;
>
> wherein the interface is configured to respond to the coherency message by sending a **proxy address packet** on the address network;
>
> wherein a different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network;
>
> wherein the given active device of the plurality of active devices has an ownership responsibility for the another coherency unit, wherein the given active device is configured to not transition the ownership responsibility for the another coherency unit in response to the address packet and to

transition the ownership responsibility for the coherency unit in response to the proxy address packet. (Emphasis added)

The Examiner asserts Rowlands1 teaches the proxy packets recited in Appellant's claim 7 at col. 5, lines 53-62, and col. 6 lines 15-28. However, Rowlands1 discloses

> As used herein, coherency commands include any communications between nodes that are used to maintain coherency between nodes. The commands may include read or write requests initiated by a node to fetch or update a cache block belonging to another node, probes to invalidate cached copies of cache blocks in remote nodes (and possibly to return a modified copy of the cache block to the home node), responses to probe commands, fills which transfer data, etc. (See Col. 5, lines 5-12) (Emphasis added)

> For example, in one embodiment, if a transaction on the interconnect **22** (e.g. a transaction issued by the processors **12** A- **12** N) accesses a cache block that is remote to the node **10** (i.e. the cache block is part of the memory coupled to a different node) and the node **10** does not have sufficient ownership to perform the transaction, the memory bridge **32** may issue one or more coherency commands to the other nodes to obtain the ownership (and a copy of the cache block, in some cases). Similarly, if the transaction accesses a local cache block but one or more other nodes have a copy of the cache block, the memory bridge **32** may issue coherency commands to the other nodes. Still further, the memory bridge **32** may receive coherency commands from other nodes, and may perform transactions on the interconnect **22** to effect the coherency commands. (See Col. 5, lines 47-62) (Emphasis added)

> Generally, a remote node may begin the coherency process by requesting a copy of a cache block from the home node of that cache block using a coherency command. The memory bridge **32** in the remote node, for example, may detect a transaction on the interconnect **22** that accesses the cache block and may detect that the remote node does not have sufficient ownership of the cache block to complete the transaction (e.g. it may not have a copy of the cache block at all, or may have a shared copy and may require exclusive ownership to complete the transaction). The memory bridge **32** in the remote node may generate and transmit the coherency command to the home node to obtain the copy or to obtain sufficient ownership. The memory bridge **32** in the home node may determine if any state changes in other nodes are to be performed to grant the requested ownership to the remote node, and may transmit

> coherency commands (e.g. probe commands) to effect the state changes. The memory bridge **32 in each node** receiving the probe commands may effect the state changes and respond to the probe commands. Once the responses have been received, the memory bridge **32** in the home node may respond to the remote node (e.g. with a fill command including the cache block). (See Col. 6, lines 6-28) (Emphasis added)

From the foregoing, Appellant submits Rowlands1 is merely disclosing that the memory bridge 32 can request, via coherency commands (probes), ownership from other nodes. In addition Rowlands1 also discloses performing transactions on the interconnect to effect the coherency commands from other nodes. However, Appellant submits the probes referred to by the Examiner are sent OUT of the node to other nodes and not within the node to the processors. In other words, the memory bridge 32 does not initiate a different kind of command such as a "proxy packet" internally on the interconnect 22 in response to receiving a coherency command from another node via the interfaces 30. Appellant contends (and argues further below) that the commands on the interconnect 22 are the same irrespective of whether they are remote or local commands.

Appellant submits neither Rowlands2 nor Chen is relied upon, nor do they teach or suggest the above limitations. Thus Appellant submits none of the cited references teach or suggest "wherein the interface is configured to respond to the coherency message by sending a proxy address packet on the address network" or "wherein a different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network" or "wherein the given active device of the plurality of active devices has an ownership responsibility for the another coherency unit, wherein the given active device is configured to not transition the ownership responsibility for the another coherency unit in response to the address packet and to transition the ownership responsibility for the coherency unit in response to the proxy address packet," as recited in claim 7.

Accordingly, Appellant submits none of the references taken either singly or in combination, teaches or suggests the combination of features recited in Appellant's claim 7.

Claims 18, and 22 recite features that are similar to features recited in claim 7. Accordingly, for at least the above stated reasons, Appellant submits that the rejection of claims 7, 18, and 22 is in error and requests reversal of the rejection. The rejection of claims 8-13, and 15 (dependent from claim 7), claims 19-20 (dependent from claim 18), and claims 23-28 (dependent from claim 22) are similarly in error for at least the above stated reasons, and reversal of the rejection is requested. Each of claims 8-15, 19-21, and 23-29 recite additional combinations of features not taught or suggested in the cited art.

Claims 14, 21, and 29

Claims 14, 21, and 29 depend from claims 7, 18, and 22, respectively. Accordingly, the rejection of claims 14, 21, and 29 is in error for at least the reasons highlighted above with regard to claims 7, 18, and 22. Additionally, each of claims 14, 21, and 29 recite a combination of features including: "wherein the address packet is a read-to-share packet and wherein the proxy address packet is a proxy read-to-share-modified packet."

In regard to the rejection of claim 14, and the Examiner's assertion that rdShs and cRdShd commands of Rowlands1 are analogous to Appellant's read to share and proxy read to share modified packets, respectively, Appellant respectfully disagrees. Specifically, the "c" commands referred to in Rowlands1 are coherent commands issued to other nodes by the memory bridge 32, in response to commands received locally on the interconnect 22, which is the opposite of that claimed by Appellant. Rowlands1 discloses

> The cRdShd or cRdExc commands may be issued by the memory bridge **32** in response to RdShd or RdExc transactions on the interconnect **22** , respectively, to read a remote cache block not stored in the node (or, in the case of RdExc, the block may be stored in the node but in the shared state). If the cache block is stored in the node (with exclusive ownership, in the case of the RdExc

> transaction), the read is completed on the interconnect **22** without any coherency command transmission by the memory bridge **32** . (*See* col. 19, ines 24-27) (Emphasis added)
>
> …a decision tree for a read transaction to a memory space address on the interconnect **22** of a node **10** is shown for one embodiment. The decision tree may illustrate operation of the node **10** for the read transaction for different conditions of the transaction, the state of the cache block accessed by the transaction, etc. The read transaction may, in one embodiment, include the RdShd, RdExc, RdKill, and RdInv transactions shown in the table **142** of FIG. **8** . (*See* col. 21, lines 11-19) (Emphasis added)

From the foregoing, it is clear to Appellant that the RdShd command is sent on the interconnect 22 regardless of whether the coherency command is a local request (i.e., from a processor within the node) or a remote request (i.e., from a processor in another node), and the cRdShd is sent by the memory bridge 32 to other nodes (not internally on interconnect 22) in response to a local RdShd command. Accordingly, this further illustrates that Rowlands1, does not disclose sending a proxy address packet on the internal address network if the coherency request comes from the interface in response to a remote coherency request, and a local active device sends an address packet on the address network within the node.

For at least the above stated reasons, Appellant submits that the rejection of claims 14, 21, and 29 is in error and requests reversal of the rejection.

Second Ground of Rejection:

Claims 16 and 17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Rowlands1 in view of Rowlands2, Chen, and Hagersten. Appellant submits the rejection of claims 16 and 17 is in error for at least the reasons highlighted above with regard to claims 7, 18, and 22.

CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejection of claims 7-29 is erroneous, and reversal of his decision is respectfully requested.

The Commissioner is authorized to charge any fees and/or credit any overpayments that may be due to Meyertons, Hood, Kivlin, Kowert, & Goetzel, P.C. Deposit Account No. 501505/5181-25901/SJC.

Respectfully submitted,

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VIII. APPENDIX

The claims on appeal are as follows.

7. A multi-node system, comprising:

a node including a plurality of active devices and an interface coupled by an address network configured to convey address packets between the interface and the plurality of active devices, and a data network configured to convey data packets between the interface and the plurality of active devices, wherein the address network and the data network are separate networks;

an inter-node network configured to convey coherency messages between the interface in the node and an additional interface in an additional node, wherein the additional interface is configured to send a coherency message requesting a read access right to a coherency unit on the inter-node network, wherein a given active device of the plurality of active devices has an ownership responsibility for the coherency unit;

wherein the interface is configured to respond to the coherency message by sending a proxy address packet on the address network;

wherein a different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network;

wherein the given active device of the plurality of active devices has an ownership responsibility for the another coherency unit, wherein the given active

device is configured to not transition the ownership responsibility for the another coherency unit in response to the address packet and to transition the ownership responsibility for the coherency unit in response to the proxy address packet.

8. The system of claim 7, wherein the additional interface in the additional node is configured to send the coherency message in response to an additional active device included in the additional node requesting a read access right to the coherency unit.

9. The system of claim 8, wherein the additional active device is configured to request the read access right to the coherency unit by sending an additional address packet on an additional address network included in the additional node.

10. The system of claim 8, wherein the given active device is configured to send a data packet corresponding to the coherency unit on the data network in response to receiving the proxy address packet, wherein the interface included in the node is configured to send data corresponding to the coherency unit to the additional interface via the inter-node network in response to the data packet on the data network.

11. The system of claim 10, wherein the additional interface is configured to send an additional data packet corresponding to the coherency unit on an additional data network included in the additional node in response to receiving the data via the inter-node network.

12. The system of claim 11, wherein the additional active device is configured to gain the read access right to the coherency unit in response to receiving the additional data packet from the additional data network.

13. The system of claim 10, wherein the given active device is configured to transition an access right to the coherency unit in response to sending the data packet on the data network.

14. The system of claim 7, wherein the address packet is a read-to-share packet and wherein the proxy address packet is a proxy read-to-share-modified packet.

15. The system of claim 7, wherein no other active device in any–node has an ownership responsibility for the coherency unit subsequent to receipt of the proxy address packet by the active device.

16. The system of claim 7, wherein if any active device in any node has an ownership responsibility for a particular coherency unit, no other active device in any other node has a valid access right to the particular coherency unit.

17. The system of claim 16, wherein if any active device in-any node has a read access right to the particular coherency unit, no active device in any other node has a write access right to the particular coherency unit.

18. A node for use in a multi-node system, the node comprising:

an address network configured to convey address packets and a separate data network configured to convey data packets;

a plurality of active devices coupled to send and receive address packets on the address network and data packets on the data network, wherein a given active device of the plurality of active devices has an ownership responsibility for a coherency unit; and

an interface coupled to additional nodes in the multi-node system via an inter-node network, wherein the interface is configured to send and receive address packets on the address network and data packets on the data network, wherein the interface is configured to receive a coherency message from a given additional node via the inter-node network, wherein the coherency message requests a read access right to the coherency unit;

wherein the interface is configured to respond to the coherency message by sending a proxy address packet on the address network;

wherein a different active device of the plurality of active devices is configured to request a read access right to another coherency unit by sending an address packet on the address network;

wherein the given active device of the plurality of active devices has an ownership responsibility for the another coherency unit, wherein the given active device is configured to not transition the ownership responsibility for the another coherency unit in response to the address packet and to transition

the ownership responsibility for the coherency unit in response to the proxy address packet.

19. The node of claim 18, wherein the given active device is configured to send a data packet corresponding to the coherency unit on the data network in response to receiving the proxy address packet, wherein the interface included in the node is configured to send data corresponding to the coherency unit to the given additional node via the inter-node network in response to the data packet on the data network.

20. The node of claim 19, wherein the given active device is configured to transition an access right to the coherency unit in response to sending the data packet on the data network.

21. The node of claim 18, wherein the address packet is a read-to-share packet and wherein the proxy address packet is a proxy read-to-share-modified packet.

22. A method for use in a multi-node system comprising a node and an additional node coupled by an inter-node network, the method comprising:

the additional node sending a coherency message requesting a read access right to a coherency unit on the inter-node network;

in response to receiving the coherency message, an interface included in the node sending a proxy address packet on an address network included in the node;

an active device included in the node losing an ownership responsibility for the coherency unit in response to receiving the proxy address packet;

a different active device included in the node requesting a read access right to another coherency unit by sending an address packet on the address network;

the active device maintaining an ownership responsibility for the another coherency unit in response to the address packet.

23. The method of claim 22, further comprising an additional interface included in the additional node sending the coherency message in response to an additional active device included in the additional node requesting the read access right to the coherency unit.

24. The method of claim 23, wherein said additional node requesting comprises the additional active device sending an additional address packet on an additional address network included in the additional node.

25. The method of claim 23, further comprising:

the active device sending a data packet corresponding to the coherency unit on a data network included in the node in response to receiving the proxy address packet; and

the interface included in the node sending data corresponding to the coherency unit to the additional interface via the inter-node network in response to the data packet on the data network.

26. The method of claim 25, further comprising the additional interface sending an additional data packet corresponding to the coherency unit on an additional data network included in the additional node in response to receiving the data via the inter-node network.

27. The method of claim 26, further comprising the additional active device gaining the read access right to the coherency unit in response to receiving the additional data packet from the additional data network.

28. The method of claim 25, further comprising the active device transitioning an access right to the coherency unit in response to sending the data packet on the data network.

29. The method of claim 22, wherein the address packet is a read-to-share packet and wherein the proxy address packet is a read-to-share-modified packet.

IX. EVIDENCE APPENDIX

No evidence submitted under 37 C.F.R. §§ 1.130, 1.131, or 1.132 or otherwise entered by the Examiner is relied upon in this appeal.

X. RELATED PROCEEDINGS APPENDIX

There are no related proceedings.